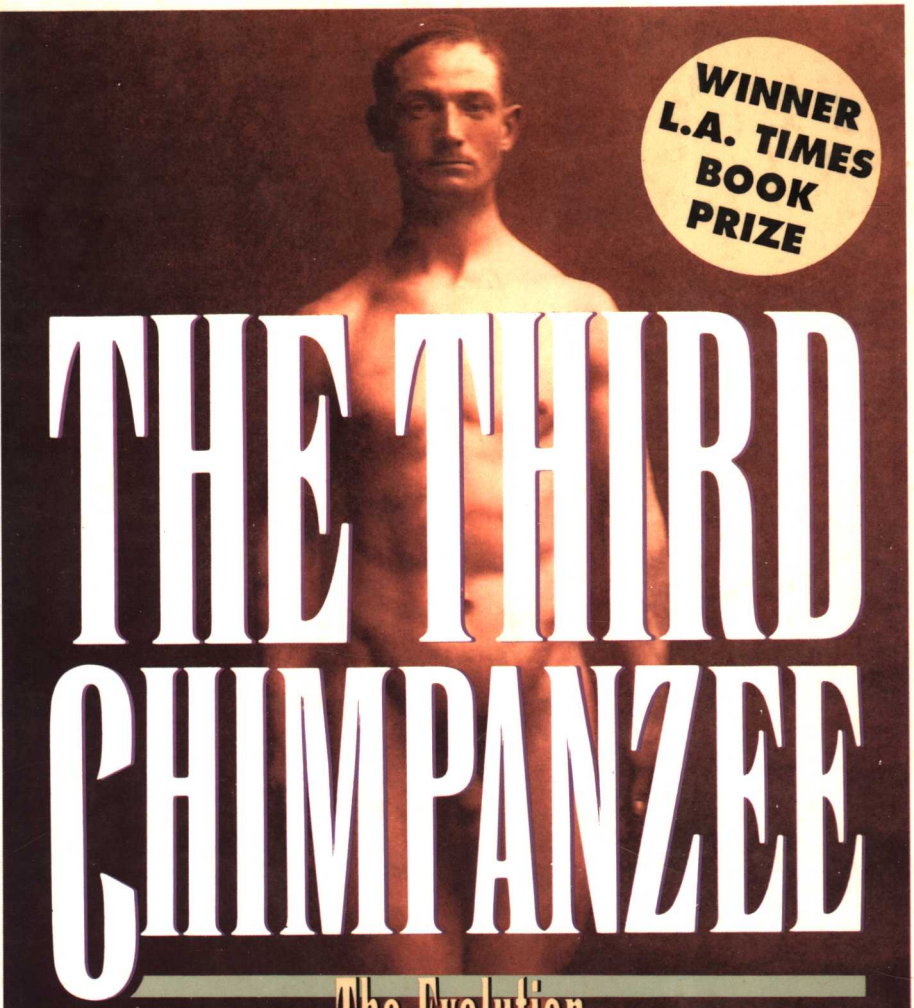

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THE THIRD CHIMPANZEE

The Evolution and Future of the Human Animal

JARED DIAMOND

"Written with great wit and a pleasure to read....The book's provocative style forces one to reflect thoroughly on the puzzle of human evolution, and where we came from and where we may be heading." —*New York Times Book Review*

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The Evolution and Future OF THE *Human Animal*

JARED DIAMOND

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Prologue

IT'S OBVIOUS THAT humans are unlike all animals. It's also obvious that we're a species of big mammal, down to the minutest details of our anatomy and our molecules. That contradiction is the most fascinating feature of the human species. It's familiar, but we still have difficulty grasping how it came to be and what it means.

On the one hand, between us and all other species lies a seemingly unbridgeable gulf that we acknowledge by defining a category called "animals." It implies that we consider centipedes, chimpanzees, and clams to share decisive features with each other but not with us, and to lack features restricted to us. Among those unique characteristics of ours, we talk, write, and build complex machines. We depend on tools, not on our bare hands, to make a living. Most of us wear clothes and enjoy art, and many of us believe in a religion. We are distributed over the whole Earth, command much of its energy and production, and are beginning to expand into the ocean depths and into Space. We're also unique in darker behaviors, including genocide, delight in torture, addiction to toxic drugs, and extermination of other species by the thousands. While a few animal species have one or two of

these behaviors in rudimentary form (like tool use), we still far eclipse animals in even those respects.

Thus, for practical and legal purposes, humans aren't considered animals. When Darwin proposed in 1859 that we had evolved from apes, it's no wonder that most people initially regarded his theory as absurd and continued to insist that we had been separately created by God. Many people, including a quarter of all American college graduates, still hold to that belief today.

But, on the other hand, we obviously are animals, with the usual animal body parts, molecules, and genes. It's even clear what particular type of animal we are. Externally, we're so similar to chimpanzees that eighteenth-century anatomists who believed in divine creation could already recognize our affinities. Just imagine taking some normal people, stripping off their clothes, taking away all their other possessions, depriving them of the power of speech, and reducing them to grunting, without changing their anatomy at all. Put them in a cage in the zoo next to the chimp cages, and let the rest of us clothed and talking people visit the zoo. Those speechless caged people would be seen for what we all really are: chimps that have little hair and walk upright. A zoologist from Outer Space would immediately classify us as just a third species of chimpanzee, along with the pygmy chimp of Zaire and the common chimp of the rest of tropical Africa.

Molecular genetic studies of the last half-dozen years have shown that we continue to share over 98 percent of our genetic program with the other two chimps. The overall genetic distance between us and chimps is even smaller than the distance between such closely related bird species as red-eyed and white-eyed vireos. Thus, we still carry most of our old biological baggage with us. Since Darwin's time, fossilized bones of hundreds of creatures variously intermediate between apes and modern humans have been discovered, making it impossible for a reasonable person to deny the overwhelming evidence. What once seemed absurd—our evolution from apes—actually happened.

Yet the discoveries of many missing links have only made the problem more fascinating, without fully solving it. The few bits of new baggage we acquired—the 2 percent difference between our genes and those of chimps—must have been responsible for all of our seemingly unique properties. We underwent some small changes

with big consequences rather quickly and recently in our evolutionary history. In fact, as recently as a hundred thousand years ago that zoologist from Outer Space would have viewed us as just one more species of big mammal. Granted, we had a couple of curious behaviors, notably our control of fire and our dependence on tools. But those behaviors would have seemed no more curious to the extraterrestrial visitor than would the behaviors of beavers and bowerbirds. Somehow, within a few tens of thousands of years—a period that is almost infinitely long when measured against one person's memory but is only a tiny fraction of our species' separate history—we had begun to demonstrate the qualities that make us unique and fragile.

What were those few key ingredients that made us human? Since our unique properties appeared so recently and involved so few changes, those properties or at least their precursors must already be present in animals. What are those animal precursors of art and language, of genocide and drug abuse?

OUR UNIQUE QUALITIES have been responsible for our present biological success as a species. No other large animal is native to all the continents, or breeds in all habitats from deserts and the Arctic to tropical rainforests. No large wild animal rivals us in numbers. But among our unique qualities are two that now jeopardize our existence: our propensities to kill each other and to destroy our environment. Of course, both propensities occur in other species: lions and many other animals kill their own kind, while elephants and others damage their environment. However, these propensities are much more threatening in us than in other animals because of our technological power and exploding numbers.

There's nothing new about prophecies to the effect that the world's end is near if we don't repent. What's new is that this prophecy is now likely to come true, for two obvious reasons. First, nuclear weapons give us the means to wipe ourselves out quickly; no humans possessed this means before. Second, we already appropriate about 40 percent of the Earth's net productivity (i.e., the net energy captured from sunlight). With the world's human population now doubling every forty-one years, we soon shall reach the biological limit to growth, at which point we shall have to start fighting each other in dead earnest for a share of the world's fixed pie of resources. In

addition, given the present rate at which we are exterminating species, most of the world's species will become extinct or endangered within the next century, but we depend on many species for our own life support.

Why rehearse these familiar depressing facts? And why try to trace the animal origins of our destructive qualities? If they really are part of our evolutionary heritage, that seems to say that they are genetically fixed and hence unchangeable.

In fact, our situation is not hopeless. Perhaps the urge to murder strangers or sexual rivals is innate in us. But that still hasn't prevented human societies from attempting to thwart those instincts, and from succeeding in sparing most people the fate of being murdered. Even taking two world wars into account, proportionately far fewer people have died violent deaths in twentieth-century industrialized states than in Stone Age tribal societies. Many modern populations enjoy longer life spans than did humans of the past. Environmentalists don't always lose in battles with developers and destroyers. Even some genetic infirmities, such as phenylketonuria and juvenile-onset diabetes, can now be mitigated or cured.

My purpose in rehearsing our situation is to help us avoid repeating our mistakes—to use knowledge of our past and our propensities in order to change our behavior. That's the hope behind the dedication of this book. My twin sons were born in 1987 and will reach my present age in the year 2041. What we are doing now is shaping their world.

It is not the goal of this book to propose specific solutions to our predicament, because the solutions we should adopt are already clear in broad outline. Some of those solutions include halting population growth, limiting or eliminating nuclear weapons, developing peaceful means for solving international disputes, reducing our impact on the environment, and preserving species and natural habitats. Many excellent books make detailed proposals for how to carry out these policies. Some of these policies are being implemented in some cases now; we "just" need to implement them consistently. If we all became convinced today that they were essential, we would already know enough to start carrying them out tomorrow.

Instead, what is lacking is the necessary political will. Through this book I seek to foster that will, by tracing our history as a species. Our problems have deep roots tracing back to our animal ancestry. They

have been growing for a long time with our growing power and numbers, and are now steeply accelerating. We can convince ourselves of the inevitable outcome of our current shortsighted practices just by examining the many past societies that destroyed themselves by destroying their own resource base, despite having less potent means of self-destruction than ours. Political historians justify the study of individual states and rulers by the resulting opportunity to learn from the past. That justification applies even more to the study of our history as a species, because the lessons of that study are simpler and clearer.

A VOLUME that ranges over such a broad canvas as this one has to be selective. Every reader is bound to find some absolutely crucial favorite subjects omitted, some other subjects pursued in inordinate detail. So that you won't feel you were misled, I'll lay out at the start my own particular interests, and where they come from.

My father is a physician, my mother a musician with a gift for languages. Whenever I was asked as a child about my career plans, my response was that I wanted to be a doctor like my father. By my last year in college, that goal had become gently transformed into the related goal of medical research. And so I trained in physiology, the area in which I now teach and do research at the University of California Medical School in Los Angeles.

However, at the age of seven I had also become interested in bird-watching, and I had been fortunate to go to a school that let me delve into languages and history. After I got my Ph.D., the prospect of devoting the rest of my life to the single professional interest of physiology began to look increasingly oppressive. At that point, a happy constellation of events and people gave me the chance to spend a summer in the highlands of New Guinea. Ostensibly, the purpose of my trip was to measure nesting success of New Guinea birds, a project that collapsed dismally within a few weeks when I found myself unable to locate even a single bird nest in the jungle. Yet the real purpose of the trip succeeded completely: to indulge my thirst for adventure and bird-watching in one of the wildest remaining parts of the world. What I saw then of New Guinea's fabulous birds, including its bowerbirds and birds of paradise, led me to develop a parallel second career, in bird ecology, evolution, and biogeography. Since

then, I've returned to New Guinea and neighboring Pacific islands a dozen times to pursue my bird research.

But I found it hard to work in New Guinea amid the accelerating destruction of the birds and forests that I loved, without getting involved in conservation biology. So I began to combine my academic research with practical work as a consultant for governments, by applying what I knew about animal distributions to designing national park systems and surveying proposed national parks. It was also hard to work in New Guinea, where languages replace each other every twenty miles, and where learning bird names in each local language proved to be the key to tapping New Guineans' encyclopedic knowledge of their birds, without returning to my earlier interest in languages. Most of all, it was hard to study the evolution and extinction of bird species without wanting to understand the evolution and possible extinction of *Homo sapiens,* by far the most interesting species of all. That interest, too, was especially hard to ignore in New Guinea, with its enormous human diversity.

Those are the paths by which I came to be interested in the particular aspects of humans that are emphasized in this book. Numerous excellent books by anthropologists and archaeologists already discuss human evolution in terms of tools and bones, which this book can therefore summarize briefly. However, those other volumes devote much less space to my particular interests of the human life cycle, human geography, human impacts on the environment, and humans as animals. Those subjects are as central to human evolution as are the more traditional subjects involving tools and bones.

I believe that what may at first seem to be a plethora of examples drawn from New Guinea is appropriate. Granted, New Guinea is just one island, located in a particular part of the world (the tropical Pacific), and hardly providing a random cross-section of modern humanity. But New Guinea harbors a much bigger slice of humanity than you would at first guess from its area. About a thousand of the world's approximately five thousand languages are spoken only in New Guinea. Much of the cultural diversity that survives in the modern world is contained within New Guinea. All highland peoples in New Guinea's mountainous interior were Stone Age farmers until very recently, while many lowland groups were nomadic hunter-gatherers and fishermen practicing somewhat casual agriculture. Local xenophobia was extreme, cultural diversity correspondingly so,

and travel outside of one's tribal territory would have been suicidal. Many of the New Guineans who have worked with me are deadly expert hunters who lived out their childhood in the days of stone tools and xenophobia. Thus, New Guinea is as good a model as we have left today of what much of the rest of the human world was once like.

THE STORY of our rise and fall divides itself into five natural parts. In the first part I'll follow us from several million years ago until just before agriculture's appearance ten thousand years ago. These two chapters deal with the evidence of bones, tools, and genes—the evidence that is preserved in the archaeological and biochemical record, and that gives us our most direct information about how we have changed. Fossilized bones and tools can often be dated, permitting us to deduce in addition just when we changed. We'll examine the basis of the conclusion that we're still 98 percent chimps in our genes, and we'll try to figure out what difference of 2 percent was responsible for our great leap forward.

The second part deals with changes in the human life cycle, which were as essential to the development of language and art as were the skeletal changes discussed in Part One. It's restating the obvious to mention that we feed our children after the age of weaning, instead of leaving them to find food on their own; that most adult men and women associate in couples; that most fathers as well as mothers care for their children; that many people live long enough to experience grandchildren; and that women undergo menopause. To us, these traits are the norm, but by the standards of our closest animal relatives they are bizarre. They constitute major changes from our ancestral condition, though they don't fossilize and so we don't know when they arose. For that reason they receive much briefer treatment in books on human paleontology than do our changes in brain size and pelvis. But they were crucial to our uniquely human cultural development, and merit equal attention.

With Parts One and Two thus having surveyed the biological underpinnings of our cultural flowering, Part Three proceeds to consider the cultural traits that we consider as distinguishing us from animals. Those that come first to mind are the ones of which we are proudest: language, art, technology, and agriculture, the hallmarks of

our rise. Yet our distinguishing cultural traits also include black marks on our record, such as abuse of toxic chemicals. While one can debate whether all these hallmarks rank as uniquely human, they at least constitute huge advances on animal precursors. But animal precursors there must have been, since these traits flowered only recently on an evolutionary time scale. What were those precursors? Was their flowering inevitable in the history of life on Earth? For example, so inevitable that we suspect there to be many other planets out in Space, inhabited by creatures as advanced as we are?

Besides chemical abuse, our black traits include two so serious that they may lead to our fall. Part Four considers the first of these: our propensity for xenophobic killing of other human groups. This trait has direct animal precursors—namely, the contests between competing individuals and groups that, in many species besides our own, may be resolved by murder. We've merely used our technological prowess to improve our killing power. In Part Four we'll consider the xenophobia and extreme isolation that marked the human condition before the rise of political states began to make us more homogeneous culturally. We'll see how technology, culture, and geography affected the outcome of two of the most familiar historical sets of contests between human groups. We'll then survey the worldwide recorded history of xenophobic mass murder. This is a painful subject, but here above all is an example of how our refusal to face up to our history condemns us to repeat past mistakes on a more dangerous scale.

The other black trait that now threatens our survival is our accelerating assault on our environment. This behavior too has its direct animal precursors. Animal populations that for one reason or another escaped control by predators and parasites have in some cases also escaped their own internal controls on their numbers, multiplied until they damaged their resource base, and occasionally eaten their way into extinction. Such a risk applies with special force to humans, because predation on us is now negligible, no habitat is beyond our influence, and our power to kill individual animals and destroy habitats is unprecedented.

Unfortunately, many people still cling to the Rousseauian fantasy that this behavior did not appear in us until the Industrial Revolution, before which we lived in harmony with Nature. If that were true, we would have nothing to learn from the past except how

virtuous we once were and how evil we have now become. Part Five seeks to dismantle this fantasy by facing up to our long history of environmental mismanagement. In Part Five as in Part Four, the emphasis is on recognizing that our present situation is not novel, except in degree. The experiment of trying to manage a human society while mismanaging its environment has already been run many times, and the outcome is there for us to learn from.

This book concludes with an epilogue that traces our rise from animal status. It also traces the acceleration in our means to bring about our fall. I wouldn't have written this book if I had thought that the risk was remote, but I also wouldn't have written it if I had considered us doomed. Lest any readers get so discouraged by our track record and present predicament that they overlook this message, I point out the hopeful signs and the ways in which we can learn from the past.

PART ONE

JUST ANOTHER SPECIES OF BIG MAMMAL

The clues about when, why, and in what ways we ceased to be just another species of big mammal come from three types of evidence. Part One considers some of the traditional evidence from archaeology, which studies fossil bones and preserved tools, plus newer evidence from molecular biology.

One basic question concerns just how extensive the genetic differences between us and chimps are. That is, do our genes differ by 10, 50, or 99 percent from chimpanzee genes? Merely eyeballing humans and chimps or counting up visible traits wouldn't be any help, because many genetic changes have no visible effects at all, while other changes have sweeping effects. For example, the visible differences between breeds of dogs such as Great Danes and Pekinese are far greater than those between chimps and us. Yet all dog breeds are interfertile, breed with each other (insofar as it's mechanically feasible) when given the opportunity, and belong to the same species. To a naïve observer, a glance at Great Danes and Pekinese would have suggested them to be genetically much further apart than chimps are from humans. Those visible differ-

ences among dog breeds in size, proportions, and hair color depend on relatively few genes, which have negligible consequences for reproductive biology.

How, then, can we estimate our genetic distance from chimps? This problem has been solved only within the past half-dozen years, by molecular biologists. The answer is not just intellectually surprising but may also have some practical ethical implications for how we treat chimps. We'll see that gene differences between us and chimps, although large compared to those among living human populations or among breeds of dogs, are still small compared to differences among many other familiar pairs of related species. Evidently, changes in only a small percentage of the chimpanzee genetic program had enormous consequences for our behavior. It has also proved possible to work out a calibration between genetic distance and elapsed time, and thereby to get an approximate answer to the question of when we and chimps split apart from our common ancestor. That turns out to be somewhere around seven million years ago, give or take a few million years.

While these molecular biological results yield overall measures of genetic distance and elapsed time, they tell us nothing about how specifically we differ from chimps, and when those specific differences appeared. Hence we'll go on to consider what more can be learned from bones and tools left by creatures variously intermediate between our apelike ancestor and modern humans. The changes in bones constitute the traditional subject matter of physical anthropology. Especially important were our increase in brain size, skeletal changes associated with walking upright, and decreases in skull thickness, tooth size, and jaw muscles.

Our large brain was surely prerequisite for the development of human language and innovativeness. One might therefore expect the fossil record to show a close parallel between increased brain size and sophistication of tools. In fact, the parallel is not at all close. This proves to be the greatest surprise and puzzle of human evolution. Stone tools remained very crude for hundreds of thousands of years after we had undergone most of our expansion of brain size. As recently as forty thousand years ago, Neanderthals had brains even larger than those of modern humans, yet their tools show no signs of innovativeness and art. Neanderthals were still just another species of big mammal. Even for tens of thou-